Space Weather Technical Forecast

Issued on Tuesday 10 December 2024 at 12:58 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Low to Moderate Solar Activity

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with three M-class flares observed, peaking M6.4 from a new region on the southeast limb. While the most active of the ten regions currently on the disc, this remains a small and apparently simple region, although this is still difficult to assess due to its location. AR3912 is now approaching the southwest limb, and expected to soon move over the horizon, but still brings the potential for some flare activity. AR3917 in the centre disc is the largest region, but remains relatively inactive, while AR3920 in the northeast has shown some increasing penumbra extent and complexity, but also remains relatively inactive. The other regions are currently small and simple.

No Earth directed CMEs were observed, with the CMEs from the M-class flares directed away from Earth.

Solar Wind / Geomagnetic Activity: Fast winds from CH98/+ very gradually faded through the period. Solar wind speeds, observed at L1 by ACE and DSCOVR eased from elevated levels of around 500 km/s to be slightly elevated at just over 400km/s. Density was below average. Interplanetary Magnetic Field (Bt) was initially Moderate at around 10nT but eased from 09/1500UTC, falling to generally Weak at 5-7nT. The north-south component (Bz) was predominately negative (southward), 5nT to -9nT. Phi angle was mainly positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp2-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at background. High energy electron flux (greater than 2MeV) observed by GOES16 was at background. The associated 24-hour fluence was below Active, with the 10/0000 UTC observation of 1.14e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to Low with a chance of M-class flares, and a slight chance of isolated X-class flares.

Solar Wind / Geomagnetic Activity: There are no Earth directed CMEs. Influence of CH98 fast winds will continue to recede with solar winds likely easing to be background, but with brief

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periods at slightly elevated remaining possible. Geomagnetic activity is forecast to be Quiet with isolated Unsettled intervals.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at background with only a very slight chance of rising in response to any notable flares, initially most likely from AR3912 but with an increasing potential from AR3917. High energy electron flux is expected to persist at Background, with a chance of Moderate spells each day, with the 24-hour fluence remaining below the Active threshold.

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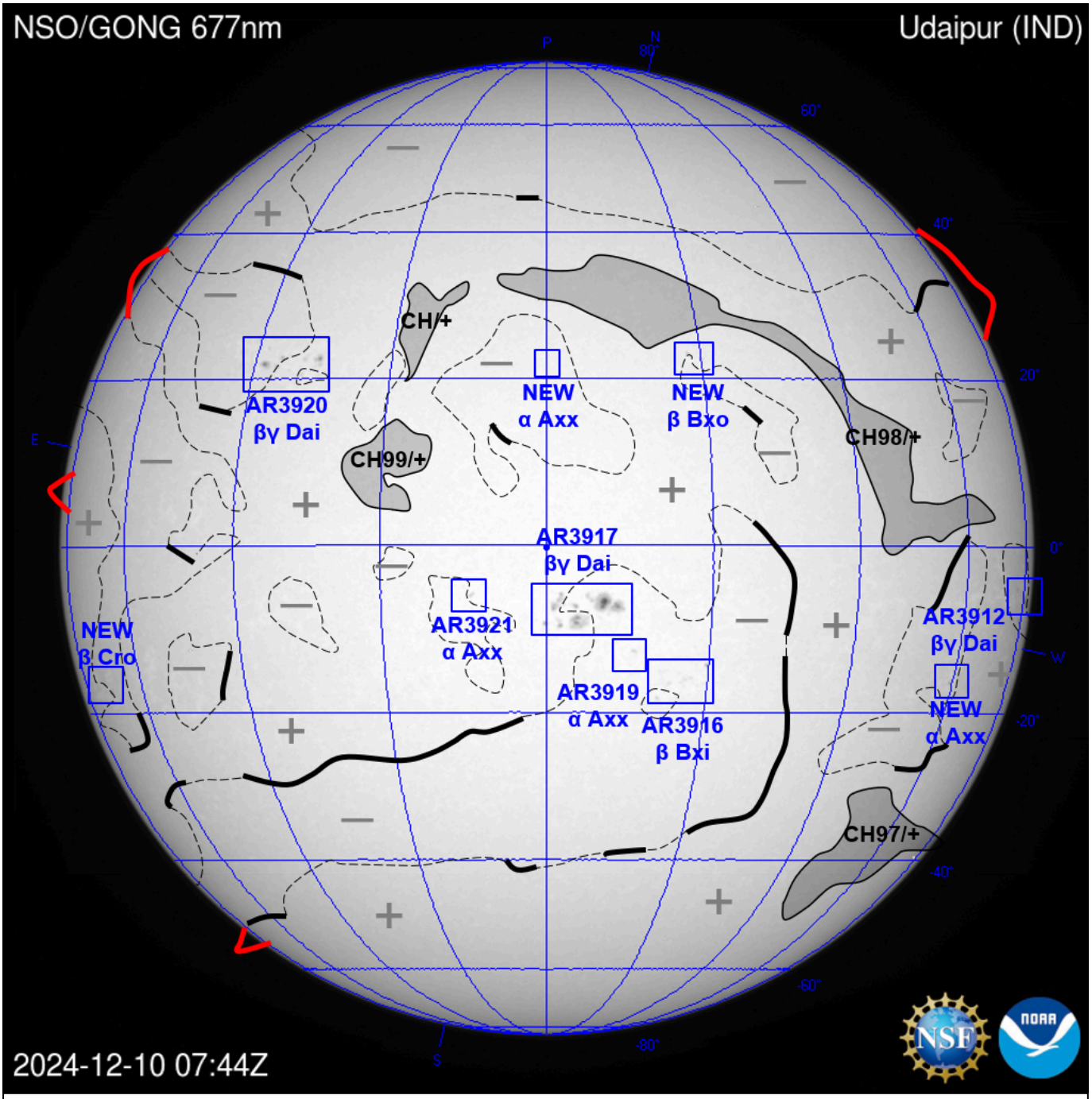
Figure 1: MOSWOC Solar Synoptic Map 10/0800 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are no Earth-directed CMEs.

Fast winds from CH98 have largely eased, with solar winds currently slightly elevated to background, and expected to persist at these speeds thorough much of the period. While CH98 is extended eastward across the northern disc, any interactions with this is expected to be minimal. The next main enhancement is likely to be from CH99, however this is not expected until after this forecast period.

MOSWOC Enlil is initially poor, with the enhancement from CH98 too late and prolonged within the model resulting in too high wind speeds at the start of the period. However, the onset of any HSS from CH99 appears more reasonable, indicated as occurring beyond this forecast period.

Mainly Quiet geomagnetic activity is forecast with isolated Unsettled spells.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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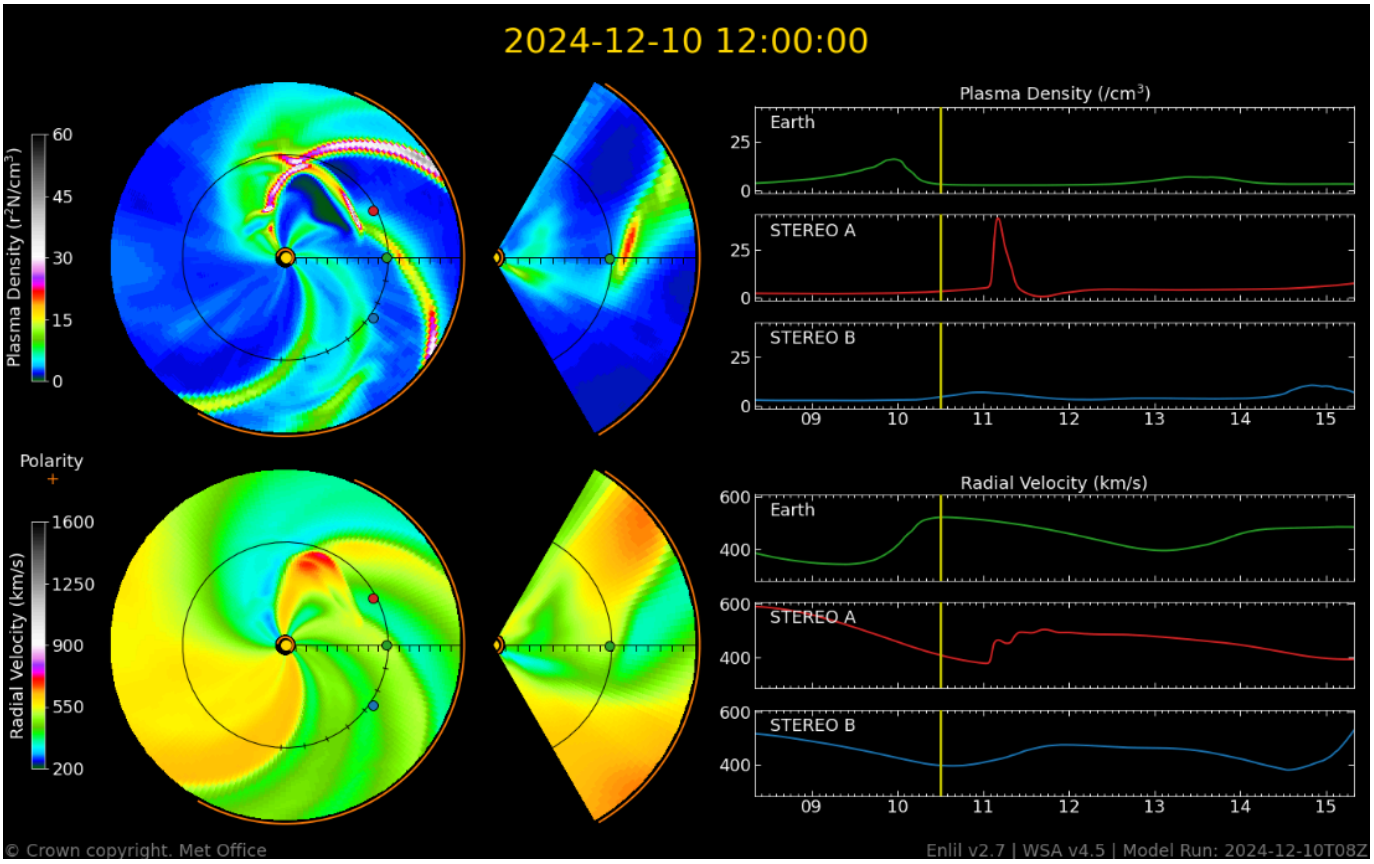
Figure 2: MOSWOC Enlil - Initial enhancement overestimated, but enhancement from 14 Dec likely due to CH99



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Radio Blackouts - X-Ray Flares

There are ten sunspot regions on the disc, and while none of these are particularly large or complex, there are a few regions of note. The most active region is currently a new unnumbered region in the southeast, with recent M-class flaring. While currently too close the southeast limb to fully assess, this region appears to be very small and relatively simple. Also of interest is AR3912, now very close the southwest limb. This was the source of the X-class flare on 08 Dec, but has since been relatively inactive. However, this is also difficult to observe due to its location, and further flares are considered possible from this region

Otherwise, AR3917 is the largest region, situated in the centre southern disc, however this has been showing some slight simplification with spreading of its component spots. Finally AR3920 in the northeast, while smaller, has shown some growth and increased complexity with small negative spots now visible to the south of its positive leader, along with some increased penumbral extent.

Overall, this gives a likelihood of further isolated M-class flares, and a slight chance of X-class flares.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	60	60	60	60
Very Active	R3-R5 (X Class)	No	10	10	5	5

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Figure 3: GOES 16-18 X-ray Irradiance

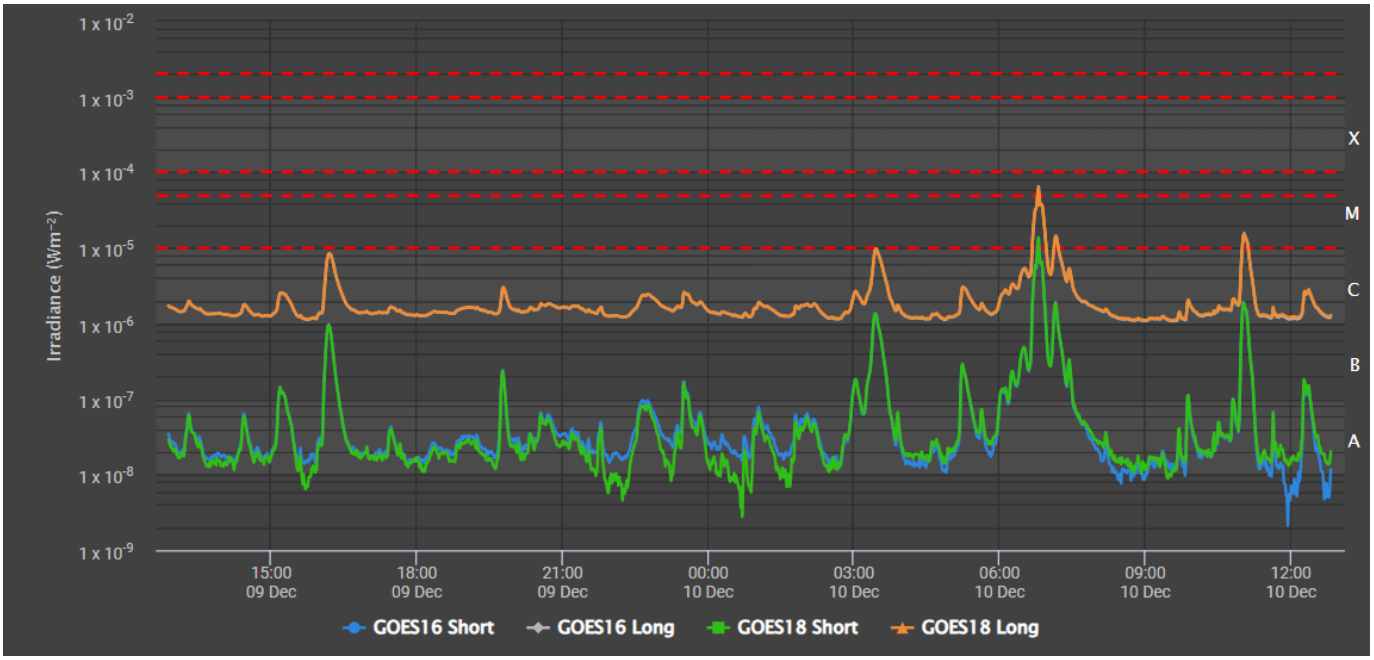
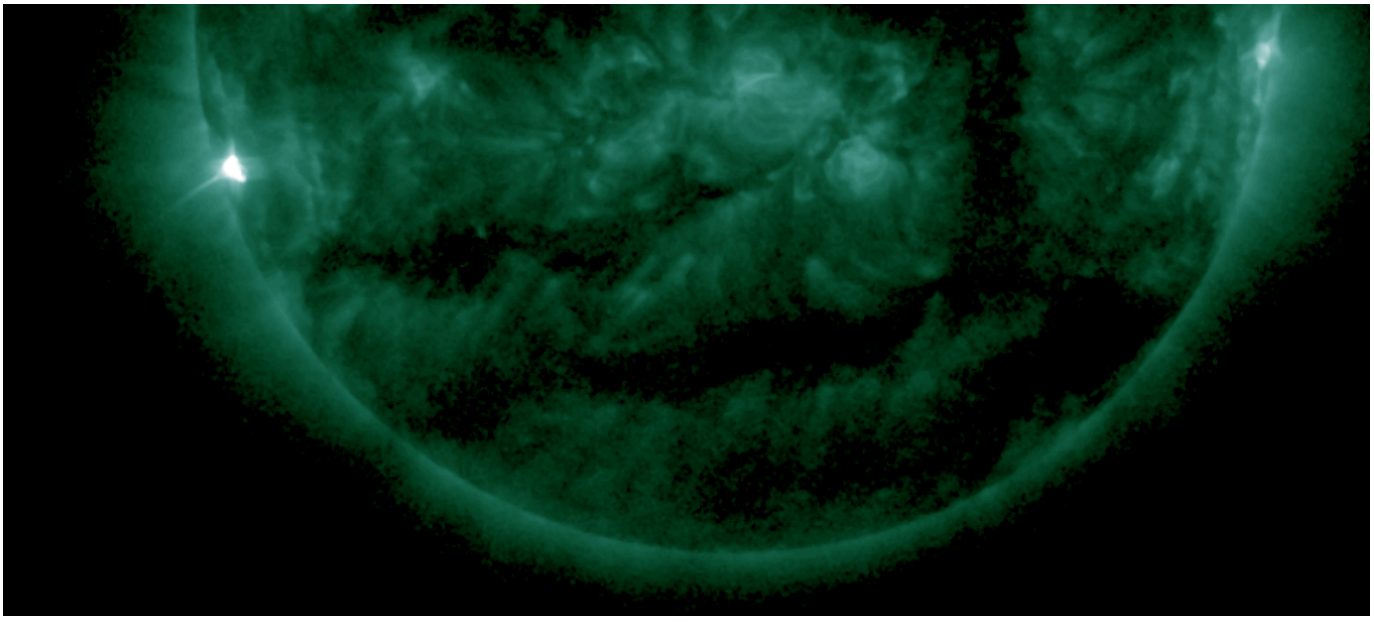


Figure 4: GOES-16 SUVI 094 at 10/0644 showing flare from NEW region.



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Solar Radiation Storms (High Energy Protons)

GOES18 proton flux is currently at background, and is expected to persist at this level, with only a very slight chance of rising in response to any notable flares. With western disc solar flares more likely to produce observable protons, the main risk is currently from AR3912, the source of the X-class flare on 08 Dec. This will soon rotate off the west limb, however there are a number of other regions on the disc, including AR3917 in the centre disc, which will then move into a slightly more prone location.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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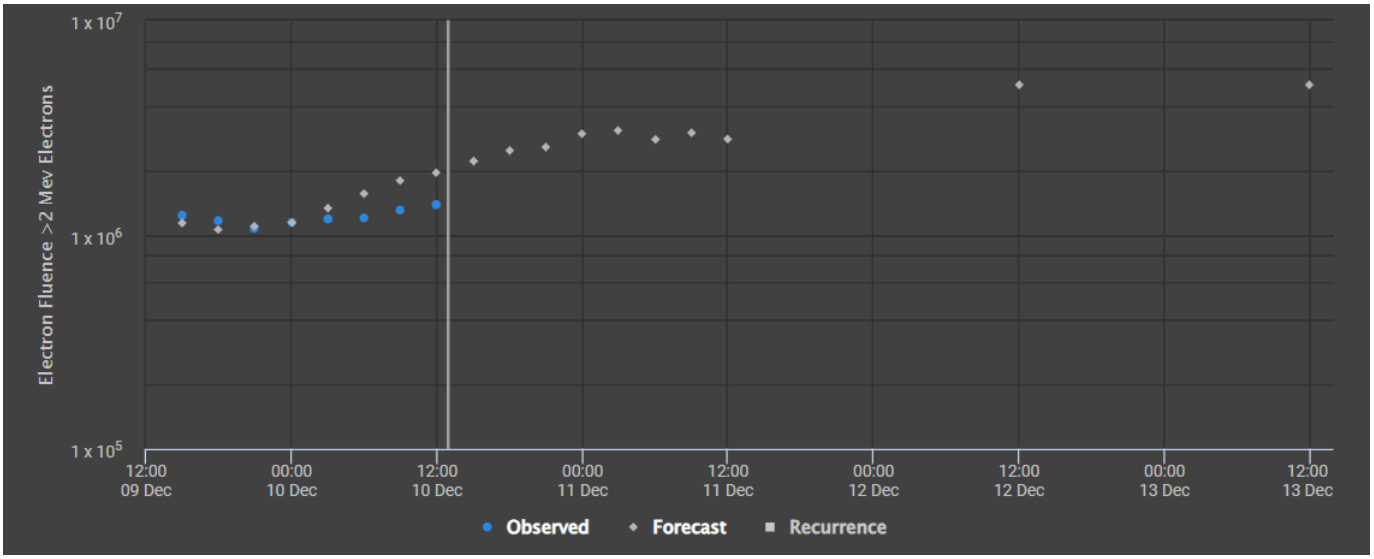
High Energy Electrons (≥ 2MeV)

High energy Electron flux observed by GOES16 has been at background. Recent solar wind enhancement from the fast wind of CH97 was relatively subdued with its geoeffective nature, despite peaking at around 500 km/s. This likely limited the charging of the Van Allen Belts, and any subsequent electron flux that will be observed through this period. Subsequently mainly Background flux is expected but likely peaking Moderate at diurnal peak. No further notable enhancements are currently forecast.

The associated 24 hr fluence is expected to remain below the Active level with MOSWOC REFM providing good guidance.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 5: GOES-16 >2MeV Electron Fluence and REFM



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